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ABSTRACT

The skill standards in this document were developed as a result of meetings between representatives of the agricultural industry and educational institutions to determine the skills and educational preparation required of an agricultural biotechnology technician, verified by technicians working in laboratories, greenhouses, animal facilities, and the field in corporations throughout the United States. The standards are intended to assist educators in developing appropriate courses of study (below the baccalaureate degree), to help students measure their progress against verified goals, and to provide the agricultural industry with skilled employees. The first two sections report on the project's scope and methodology. Part 3 contains skill standards for the following: (1) technical skills (technical communication skills, safety, basic lab skills, basic microbiology, cell biology techniques, quality control, nucleic acid techniques, protein techniques, regulatory compliance, greenhouse and growth chamber skills, plant field trials, animal care and field trials); and (2) employability skills (resources, interpersonal skills, information, and systems). Part 4 contains standards for the following: related academic skills in science, mathematics, computers, and communications; hours of instruction; qualifications of instructors; and tools and equipment. Part 5 describes emerging agricultural occupations and lists the project staff. (KC)

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ED 413 487

National Voluntary Occupational Skill Standards

Agricultural Biotechnology Technician

Preparing a skilled workforce of technicians who work in agriculture and use the tools of biotechnology.

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Voluntary, industry-Based Skill Standards

Generally, they are job-related and industry-specific. They identify the knowledge, skill and level of ability needed to perform a given job. Voluntary skill standards can be tailored to any industry to reflect its particular needs and economic environment."

U.S. Department of Education
U.S. Department of Labor

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National Voluntary Occupational Skill Standards

Agricultural Biotechnology Technician

A Special Project of the National FFA Foundation

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The National FFA Foundation affirms its belief in the value of all human beings and seeks diversity in its membership, leadership and staff.

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Participating Companies & Academic Institutions

Industry

The Agricultural Group of Monsanto Company

American Cyanamid Company, Agricultural Research Division

American Farm Bureau Federation

American Veterinary Medical Association

Biotechnology Industry Organization (BIO)

Boatmen's First National Bank of Kansas City

CENEX/Land O' Lakes

EDITEK, Inc.

Equipment Manufacturers Institute

Fermenta Animal Health Company

International Chemical Workers Union

ISK Biosciences Corporation

John Deere

Kellogg Company

Metropolitan Life Insurance Company

Na-Churs Plant Food Company

North Carolina Biotechnology Center

Pioneer Hi-Bred International, Inc.

Rhone-Poulenc Ag Company

Sandoz Agro, Inc.

Santa Fe Pacific Foundation

SIGCO/MYCOGEN Plant Sciences

The Upjohn Company, Agricultural Division

Educators

Alabama A&M University

Center for Occupational Research & Development

Colorado State University

Department of Elementary and Secondary Education, State of Missouri

National FFA Alumni Association

National Association of Supervisors of Agricultural Education

National FFA Foundation

National Post Secondary Agricultural Student Organization

National Vocational Agriculture Teachers Association

National Young Farmer Educational Association

State Department of Education, Kansas

The National Council for Agricultural Education

University of Florida

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Introduction

Agricultural biotechnology technician is an emerging occupation — one that is expected to have tremendous growth potential over the next decade and beyond. It is also an occupation that requires academic preparation in fields of science that are not currently included in the curricula of many secondary and technical schools in the United States. As a result, our challenge, in accepting a U.S. Department of Education grant to help fund this project, was not only to work with industry to determine what skills these workers need, but to consult with education to determine the feasibility of teaching these skills at the less than baccalaureate level.

The companies and institutions listed on the facing page generously donated the time of their biotechnology, education and labor experts to develop these standards. Over the course of 18 months, their representatives met many times to discuss, weigh — and, sometimes, disagree on — the skills and educational preparation required of an agricultural biotechnology technician. The results of their deliberations, contained in this booklet, were verified by technicians working in labs, greenhouses, animal facilities and the field in corporations throughout the U.S.

Agriculture education and the FFA Foundation are dedicated to providing students with the skills and information they need to make wise career choices. We also are dedicated to broadening the recognized scope of agricultural careers beyond production agriculture. We believe that biotechnology can and will make significant, positive impacts on world agriculture. We believe that the industry will grow over time, and we believe that this growth will lead to increased job opportunities for technicians who have less than a baccalaureate degree.

These skill standards are intended to assist educators in developing appropriate courses of study; to help students measure their progress against verified goals, and to provide industry with skilled employees. Our thanks to everyone who helped us meet the challenge.

Larry D. Case

Larry Case, Ed.D.
FFA National Advisor and
National FFA Organization CEO

Part One

Agricultural Biotechnology The Potential

Research in agricultural biotechnology is underway worldwide. Field studies have been conducted in Canada and the United States since 1987, and more than 300 field trials of genetically modified plants were carried out in the U.S. in 1993 alone. Hundreds of companies, universities and government agencies are involved in this research.

Progress for Today and Tomorrow

Agricultural biotechnology holds tremendous promise, not only for developing new kinds of food and fiber crops with higher nutrition value or better processing qualities, but for helping us realize a worldwide goal of sustainable agriculture. World population is expected to double by the year 2030, yet the world's arable land is rapidly being diminished. We will be able to feed our burgeoning populations only if we find ways to produce more and better food on existing acres in ways that preserve our environment. Agricultural biotechnology is key to that goal.

Today, researchers are working with a variety of crops and farm animals. Rennet for making cheese and bovine somatotropin for improving milk production in dairy cows are already on the market. Food crops are being developed for resistance to disease and insects; improved flavor and texture; higher nutrition content, and improved processing qualities. Farm animals will benefit from better feed supplements, new diagnostics and innovative pharmaceuticals.

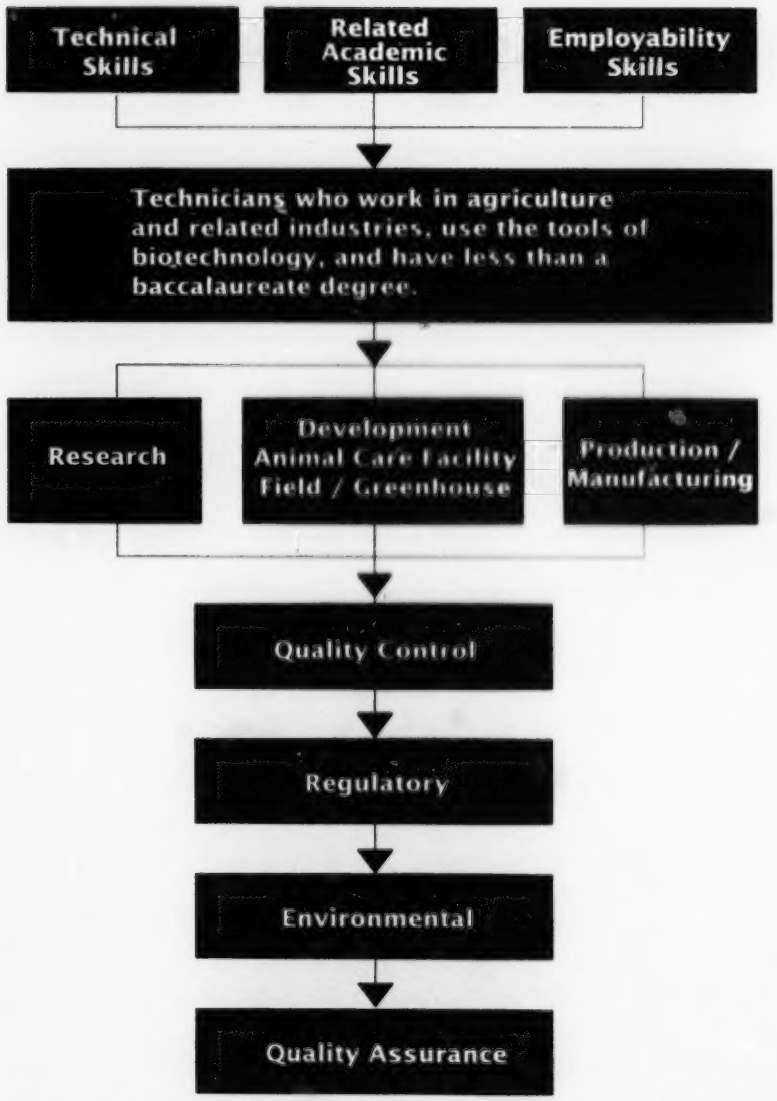
Expanding Opportunities for a Qualified Workforce

To realize its potential, the agricultural biotechnology industry will need increasing numbers of specially trained technicians — technicians who work in the laboratory performing tissue culture or DNA synthesis; who care for animals in research settings; who carry out plant field trials, or who care for and grow plants in research greenhouses and growth chambers.

Project Scope

A Broad Field Offering a Variety of Options

Because the field of agricultural biotechnology is broad it offers tremendous variety in both where you work and what you work with. Jobs will be available in traditional laboratory settings, in fields, in greenhouses or on the farm. You can work with plants, animals or microscopic organisms. You can perform sophisticated analyses in the lab, or you can raise and care for animals. But whatever you do, you'll be part of a new field of science — one that will beneficially impact the environment, world agriculture and the quality of life.



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Part Two

Methodology

The National FFA Foundation — the recipient of the U.S. Department of Education Skill Standards grant — first established a Grant Management Committee of education and biotechnology experts who worked under contract to oversee the development of the skill standards for agricultural biotechnology technician.

Working with the Grant Management Committee, specialists at the FFA Foundation then canvassed the premier agriculturally-oriented companies and universities for appointees to an Executive Committee which met three times during the course of the project to advise grant staff and review progress toward goals.

In turn, the Executive Committee appointed technical and human resources personnel from their companies or universities to serve on two subcommittees: a Technical (or Biotechnology) Subcommittee charged with developing a skill set for agricultural biotechnology technician for validation, and an Agricultural Industry Subcommittee charged with reviewing current agricultural occupation information issued by the Department of Labor and other government agencies to determine whether this information adequately conveys the universe of occupations within the agricultural industry. (See Part Five of this publication for the results of the Agricultural Industry Committee's deliberations.) The results of the Biotechnology Subcommittee's work are the focus of this publication.

After several multi-day workshops, the Biotechnology Subcommittee reached consensus on a technical skill set for agricultural biotechnology technician, as well as related academic skills needed for the job, important general employability skills for obtaining and retaining the job, hours of instruction needed by the student, suggested qualifications for their instructors, and a list of tools and equipment commonly used on the job. (See Part Four of this publication.)

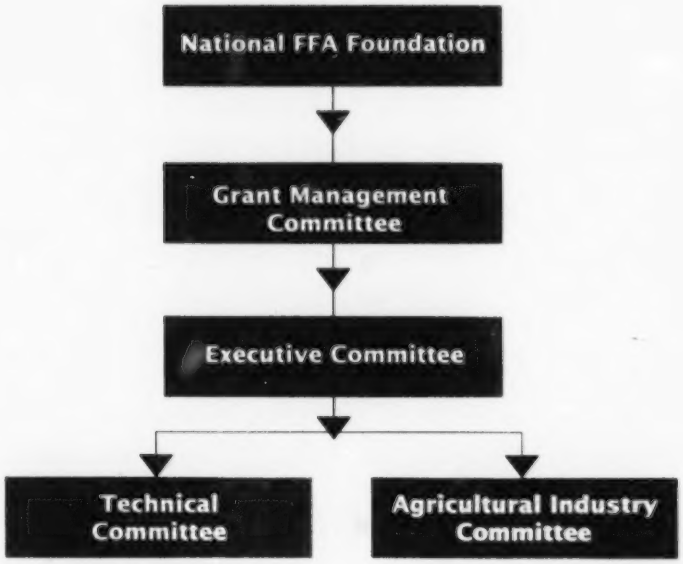
A questionnaire was developed from the committee's work which was sent to technicians working in agricultural biotechnology throughout the U.S. These workers were asked to rate each skill according to its importance to their job and the frequency with which they use it. Their responses were tabulated and analyzed, and those skills which were neither important nor frequently used were dropped from the list. The resulting skill set is listed in Part Three of this booklet.

It's important to remember that a certification program for the skills listed here will be voluntary. The list is intended to help workers prepare themselves for industry jobs, and to help industry by improving the skills of

FFA/USDE
Skill Standards
Project Organization

entry level workers. It also can assist educators in developing appropriate educational programs at the high school and technical school level.

These skill standards may one day result in a voluntary national testing and certification program for the occupation of agricultural biotechnology technician. The National FFA Foundation encourages individuals and organizations interested in improving the skills of entry level agricultural biotechnology technicians to use these standards.



- **Technical Skills**
- **Employability Skills**
- **Related Academic Skills**
- **Instructor Qualifications**
- **Hours of Study-Student**
- **Equipment**

- **Reviewed Ag. Industry Career Info**
- **Suggested Additional Careers**

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Part Three

Agricultural Biotechnology Technician Technical Skills

A.	Technical Communication Skills
A.1	Follow protocol.
A.2	Keep accurate records.
A.3	Write technical summaries.
A.4	Organize and present oral summaries.
A.5	Locate and review reference materials.
A.6	Comprehend a technical vocabulary.

B.	Safety
B.1	Identify first aid supplies, personnel and emergency protection areas.
B.2	Keep work area free from clutter.
B.3	Use appropriate safety procedures and guidelines.
B.4	Monitor, use, store and dispose of hazardous materials properly.
B.5	Use protective equipment.
B.6	Use hoods.
B.7	Maintain, understand and follow Material Safety Data Sheets (MSDS).
B.8	Maintain safety equipment.
B.9	Recognize common lab hazards.
B.10	Recognize safety symbols/signs.

C.	Basic Lab Skills
C.1	Practice aseptic techniques.
C.2	Prepare glassware.
C.3	Perform mathematical calculations and conversions.

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C.4	Make stock reagents and solutions.
C.5	Monitor physical properties of a solution.
C.6	Sterilize reagents and equipment.
C.7	Make and dispense media.
C.8	Maintain reagent integrity.
C.9	Maintain inventory of laboratory supplies.
C.10	Communicate with vendors.
C.11	Use basic weighing and measuring techniques.
C.12	Use scientific method.
C.13	Perform basic separation techniques.
C.14	Package, handle and ship biological materials.

D.	Basic Microbiology
D.1	Identify and quantify microorganisms and cells.
D.2	Isolate, maintain and store pure cultures.
D.3	Maintain and analyze fermentation materials.
D.4	Harvest cells.
D.5	Transform hosts.
D.6	Perform bioassays.

E.	Cell Biology Techniques
E.1	Isolate and characterize cell lines.
E.2	Propagate plant and animal tissue.
E.3	Use cryogenic techniques.
E.4	Use microscopes.
E.5	Perform cytological tests, i.e. sectioning and staining.
E.6	Perform bioassays.

Part Three

Agricultural Biotechnology Technician Technical Skills

F.	Quality Control
F.1	Perform validation testing.
F.2	Document product specifications.
F.3	Perform statistical and data analysis.
F.4	Use analytical equipment.
F.5	Compare results to government and/or company standards.
F.6	Collate large volumes of data.

G.	Nucleic Acid Techniques
G.1	Detect specific nucleic acid sequences.
G.2	Isolate nucleic acids.
G.3	Perform restriction digests.
G.4	Perform gel electrophoresis.
G.5	Label nucleic acids.
G.6	Perform nucleic acid sequencing procedures.
G.7	Use sequence database.
G.8	Perform basic cloning techniques.

H.	Protein Techniques
H.1	Detect specific proteins.
H.2	Precipitate/solubilize proteins.
H.3	Separate proteins, isolate or characterize proteins.
H.4	Concentrate proteins.
H.5	Perform protein assays.

I.	Regulatory Compliance
I.1	Follow regulations: U.S. Food and Drug Administration (FDA).
I.2	Follow regulations: U.S. Occupational Safety and Health Administration (OSHA).
I.3	Follow regulations: U.S. Department of Agriculture (USDA).
I.4	Follow regulations: National Institutes of Health (NIH).
I.5	Follow regulations: National Research Council (NRC).
I.6	Follow regulations: Department of Transportation (DOT).
I.7	Follow regulations: U.S. Environmental Protection Agency (EPA).
I.8	Follow state and local regulations.
I.9	Follow industry and professional regulations.
I.10	Perform research using Good Laboratory Practices (GLPs) and Good Manufacturing Practices (GMPs).

J.	Greenhouse/Growth Chamber
J.1	Maintain plants for optimal growth.
J.2	Gather pollen and hand pollinate.
J.3	Apply agrichemicals safely.
J.4	Maintain and monitor insect populations.
J.5	Apply plant pests safely.
J.6	Mix growth media.
J.7	Pot and repot plants.
J.8	Monitor growth and development of plants.
J.9	Operate computerized equipment.
J.10	Perform bioassays.

Part Three

Agricultural Biotechnology Technician Technical Skills

K.	Plant Field Trials
K.1	Perform small-scale field tests according to protocol.
K.2	Apply experimental pesticides for evaluation.
K.3	Inoculate plants and/or soil with biological materials.
K.4	Manage plants for optimal growth.
K.5	Collect biological data.
K.6	Use field database.
K.7	Perform bioassays.

L.	Animal Care and Field Trials
L.1	Monitor health and health parameters.
L.2	Feed, water and observe animals and monitor intake.
L.3	Receive and transport animals.
L.4	Monitor room conditions.
L.5	Restrain and handle animals.
L.6	Clean rooms and sterilize cages.
L.7	Maintain health records.
L.8	Maintain animal safety.
L.9	Prepare feed and prescription diets.
L.10	Collect and process specimens.
L.11	Apply knowledge of state, federal and local animal welfare regulations.

Part Three

Agricultural Biotechnology Technician Employability Skills

A.	Resources
A.1	Follow schedules.
A.2	Practice self-starting techniques
A.3	Forward information.
A.4	Perform inter-related tasks.
A.5	Demonstrate time saving habits.
A.6	Avoid procrastination.
A.7	Perform with cost awareness and consciousness.
A.8	Demonstrate effective use of resources.
A.9	Recognize contribution to corporate and employee goals.
A.10	Assess and report inventory control.
A.11	Maintain organized and neat work place.
A.12	Provide feedback to supervisors.
A.13	Recognize role of manager and technician.
A.14	Recognize the necessity of being a team member.

B.	Interpersonal Skills
B.1	Develop and use listening skills.
B.2	Develop objectivity.
B.3	Demonstrate understanding of team planning, problem solving and how communications processes and individuals contribute to the group.
B.4	Develop conflict resolution and consensus building techniques.
B.5	Explain the concepts of group trust and systems orientation, within and between teams.
B.6	Develop initiative-taking and observation skills.

B.7	Develop understanding of individual roles and responsibilities in groups.
B.8	Identify team expectations and service responsibilities.
B.9	Identify and explain diversity issues, i.e. values, workstyles, cultures.

C.	Information
C.1	Recognize unexpected results (measurement or procedural).
C.2	Document activities immediately.
C.3	Forward information appropriately.
C.4	Maintain proper laboratory notebook.
C.5	Maintain proper security of information.
C.6	Assure confidentiality of information.
C.7	Demonstrate understanding and relevance of SOPs (Standard Operating Procedures).
C.8	Read and comprehend other written documentation.
C.9	Communicate well with others.
C.10	Use word processing and spread sheet programs and perform file transfers.
C.11	Be open and adaptable to new technology and applications.

D.	Systems
D.1	Recognize the inter-relationships of technical operations/ processes (research, development, production) in private industry, academia and government.
D.2	Recognize organizational structure (chain of command).
D.3	Identify networking of people in support of organizational effort.
D.4	Self-monitor and report activities according to a prescribed list of responsibilities, standard operating procedures and protocol.

Part Four

Agricultural Biotechnology Related Academic Skills

Science

Biological

Compare living organisms by applying a classification scheme.

Identify components of nucleic acids.

Identify structure of cells and the function of their components.

Explain the carbon, oxygen and nitrogen cycles.

Explain the genetic basis of diversity.

Describe/explain bacteria in general; benefits, characteristics, protein production, resistance to drugs.

Cite and explain major cell processes such as respiration and photosynthesis.

Recognize the individual's impact on his/her physical environment.

Identify the basic unit of inheritance as the gene and recognize that genes are composed of nucleic acid.

Describe/explain genetics in general, including chromosomes, diversity, nucleic acid, dominant/recessive traits, genes, genotype/phenotype, inheritance, mitosis/meiosis, mutation, etc.

Explain sterile technique and its importance.

Describe/explain the principles of sexual and asexual reproduction in plants, fungi, animals and microbes.

Recognize that good conservation practices depend on understanding the balance between living things and their environment.

Describe the role of genetic variation and natural selection in evolution.

Describe the factors important to plant and animal breeding and production.

Explain the food chain.

Describe the functions of enzymes and metabolic pathways.

Describe the formation of proteins from nucleic acid.

Identify normal and abnormal behavior in animals.

Part Four

Agricultural Biotechnology Related Academic Skills

Explain the positive and negative aspects of insect behavior.

Compare a population growth curve to available natural resources.

Describe how micro-organisms move, obtain food, excrete waste, respond to stimuli and reproduce.

Classify micro-organisms as bacteria, fungi, yeast, viruses, etc.

Explain the role of a micro-organism as a disease vector.

Explain how micro-organisms interact with plants, animals and the environment in beneficial and detrimental ways.

Explain the use of a micro-organism as a transformation vehicle.

Name the elements necessary for plant growth.

Cite examples of relationships between plants and viruses, bacteria, fungi, vertebrate and invertebrate animals.

Explain the difference between annuals and perennials.

Explain the term "hybrid."

Recognize that populations of plants and animals change as the environment changes.

Contrast methods of pest management: biological, chemical, physical.

Explain the anatomical and physical development of animals and plants.

Explain the fundamental mechanisms of disease transmission and manifestation of plant and animal diseases.

Distinguish between an antibody and an antigen.

Physical Science

Describe/explain acids/bases in general, for acid indicators, for base indicators, for ions, for neutralization/salts, pH.

Describe/explain atoms in general; chemical equations; chemical formulas; composition, e.g. electrons, protons, neutrons; mass; number; structure; weight.

Describe/explain chemical reactions in general, in activation energy, catalysts, concentration, endothermic, energy changes, exothermic, inhibitors, moles, reactants.

Describe/explain electrons in general, in chemical bonding, covalent bonding, electric charges, ionic bonds.

Describe/explain distillation, polar/non-polar, saturated/unsaturated, soluble/insoluble, solute, solvent.

Identify organic and inorganic compounds.

Use the periodic table.

Recognize basic functional groups and the common chemical reactions in which they are involved.

Explain the basic concept and impact of energy and its interaction with biological materials.

Scientific Method

Analyze/evaluate experimental conclusions, conflicting data, controls, data, inferences, limitations, operational questions, replications, samples, sources of errors, variables.

Apply/use scientific methods in general; for qualitative/quantitative analysis; data gathering; direct and indirect observation; predictions; problem identification.

Apply/use scientific notation.

Recognize that experimental results must be open to the scrutiny of others.

Recognize the differences between methods used by scientists and how they may affect experimental results.

Demonstrate various ways to display the same data.

Distinguish between dependent and independent variables in an experiment.

Demonstrate ability to use models to interpret scientific phenomena.

Part Four

Agricultural Biotechnology Related Academic Skills

Apply observation, hypothesis, theory, model, law and assumption to everyday situations.

Identify and understand the ethical dilemmas involved in science.

Math and Computers

Computations

Perform basic mathematical computations using addition, subtraction, multiplication and division using whole numbers, integers, fractions, decimals and logarithms.

Metric System

Recognize appropriate units of measurement for the specific research.

Recognize appropriate levels of significance in numbers generated from instrumentation and/or biological variation.

Convert units within the metric system (volume, weight, length, area, temperature, pressure).

Convert units between metric and English system.

Use the metric system.

Scientific Notation

Express a number in scientific notation and/or standard notation.

Multiply and divide numbers in scientific notation using laws of exponents.

Algebra

Interpret ratios.

Solve linear equations.

Determine equivalent forms of a formula.

Convert word problems to mathematical expressions.

Interpret mathematical results to words relative to the research objective.

Apply order of operations/rules.

Use linear regression to forecast data.

Statistics

Use common measures of descriptive statistics (e.g. mean, standard deviation, etc.)

Interpret descriptive statistics appropriate to the research project.

Read and interpret statistical charts and tables.

Create and demonstrate appropriate displays for a given set of data (e.g. graph, table, chart).

Recognize anomalies in data collection.

Computer Literacy

Use a basic word processing system.

Enter, store and retrieve numerical data.

Transfer data files.

Create and use a spreadsheet.

Use spreadsheet functions for data manipulation.

Visually depict data using graphs and/or charts.

Part Four

Agricultural Biotechnology Related Academic Skills

Communications

Written Communication

Write summaries of results for reports.

Create, follow and record protocols and standard operating procedures.

Maintain a legible laboratory notebook.

Write a business letter and memo.

Proofread and edit written materials for spelling and grammatical correctness.

Reference Materials

Collect and organize information from library resources, reference books, scientific journals and electronic databases.

Access a technical support system (e.g. bulletins, service representatives).

Comprehension

Follow written and/oral information or instructions.

Explain the purpose of the research objective.

Evaluate content of oral messages and respond appropriately (e.g. listening skills).

Oral Communication

Plan, organize and deliver oral presentations in a structured and non-structured setting.

Part Four

Agricultural Biotechnology Hours of Instruction—Student

Technical Skills		Hours of Study
A.	Technical Communication	108
B.	Safety	90
C.	Basic Lab Skills	198
D.	Basic Microbiology	126
E.	Cell Biology Techniques	90
F.	Quality Control	30
G.	Nucleic Acid Techniques	126
H.	Protein Techniques	126
I.	Regulatory Compliance	90
J.	Greenhouse/Growth Chamber	126
K.	Plant Field Trials	90
L.	Animal Care and Field Trials	126

Employability Skills		Hours of Study
A.	Resources	50
B.	Interpersonal Skills	50
C.	Information	50
D.	Systems	50

Note: The Hours of Instruction — Student are based on a model program preparing Biotechnology Laboratory Technicians at Madison Area Technical College (MATC) in Madison, Wisconsin and include instruction of related academic skills appropriate to the technical skills. At MATC, a semester course commonly includes one hour of lecture and six hours of laboratory experience per week for a total of 126 hours of study per course.

Part Four

Agricultural Biotechnology Qualifications of an Instructor

Secondary School Teacher

1. Bachelor's degree:
   Major: One of the Life Sciences, including Agriculture or Agricultural Education
   Minor: Education
2. Teaching Certification
3. Minimum of 300 hours of applied research.
4. Continuing education in research procedures, techniques and equipment.

Technical College or Community College Teacher

1. Bachelor's degree or equivalent experience in a life science (biology, biochemistry, genetics, molecular biology, chemistry, cell biology, etc).
2. A minimum of two years or 4,000 hours of recent research experience in an industrial or academic biotechnology laboratory.

Part Four

Agricultural Biotechnology Tools and Equipment

Assorted clamps
Assorted cleaning chemicals
Automatic diluting system
Balance
Bar code reader
Cages and related equipment
Calculators
Carboys
Cell counters
Centrifuges
Colorimeter
Columns
Computer hardware
Computer software
Condensers
Conductivity Meter
Cryostats
Dark room equipment
Dessicator
Electrophoresis equipment
Exhaust hoods
FAX
Filters
Fluorescent microscope
Freeze dryers
Geiger counter
Germicides
Glassware
Heating block
Hemocytometer
High pressure vacuum pumps
Holding tanks
Homogenizer
Hoses
Hot plates
Incinerator
Incubator
Intercom
Laminar flowhood
Magnetic stir plates
Micro-pipette
Nitrogen storage tanks
Oscilloscope
Ovens and dryers
Pagers
pH meter
Photocopier
Pipette tips
Pipettes
Plate reader
Pressure gauges
Printers
Pumps
Radioisotopes
Reference materials
Refractometer
Refrigerators, freezers
Rotators
Rotovaps
Safety equipment
Scintillation counters
Scoopers
Shakers/mixers
Shields
Spectrometer
Syringes, needles
Telephone
Thermometer
Timers
Tubes
Typewriter
Ultra filtration unit
UV light
Voltmeter
Vortex
Water baths
Water purification systems

Part Five

Emerging Agricultural Occupations

The following occupations which require less than a baccalaureate degree and have good prospects for future employment opportunity were recommended by the USDE/FFA Agricultural Industry Subcommittee as candidates for future skill standards projects. The committee also recommended that these occupations be further researched and added to the various government career publications, such as the Dictionary of Occupational Titles, which students, teachers and guidance counselors consult for career information.

Environmental Assessment & Monitoring Technician

An environmental assessment and monitoring technician visually inspects property, investigates records and interviews historically responsible parties to identify environmental problems or risks related to natural resource protection; samples air, water and soil quality to define the scope of an identified problem or monitors changes in the environment and reports findings. This person may also:

- supervise remediation of an environmental problem;
- complete testing and analysis on site;
- serve as an expert witness;
- communicate with the public and the press.

Information Technologist

An information technologist installs, maintains and repairs computers and computer-controlled equipment to improve productivity and reduce costs by performing diagnostic tests, isolating malfunctions, installing and adjusting equipment as required and maintaining detailed records of service calls. This person may also:

- provide feedback to design team and customers.

Quality Control Technician

A quality control technician checks product performance/characteristics to ensure regulatory compliance and minimize liability using physical, chemical and biological test equipment and instrumentation to ensure that the product is within acceptable tolerances. This person may also:

- approve compliance with standard operating procedures;
- authorize product release;
- review test results against specifications.

Turf and Landscape Technician

A turf and landscape technician supports the landscape industry through the production, installation and maintenance of turf and plant material, and provides total care of turf and plant materials by mowing, fertilizing, trimming and installing plants, and applying pesticides. This person must be able to identify harmful weeds, insects and plant diseases. Certification is required in some states.

Horticultural Technician

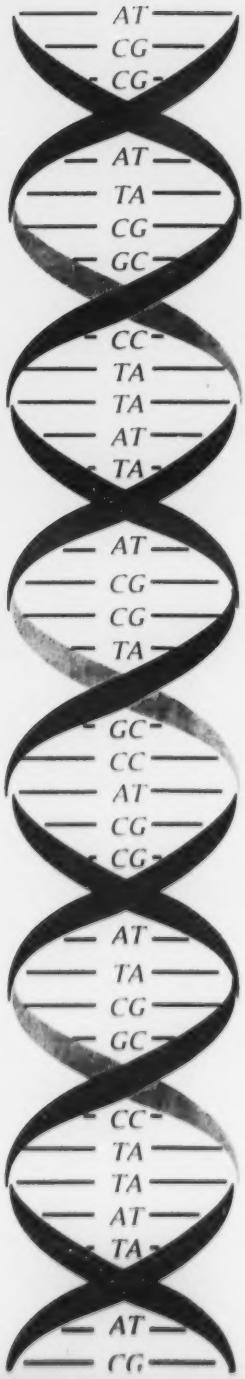
A horticultural technician is responsible for the production and care of ornamental plants by working in greenhouses, developing interiorscapes, doing floral design, working in orchards, and applying pesticides. This person must be able to identify harmful weeds, insects and plant diseases. certification is required in some states.

Food Processing Industry

The subcommittee also recommended that occupations in food processing, food science and value-added agriculture should be included under agricultural industry careers. Positions requiring less than a bachelor's degree will be found in procurement, processing, distribution, marketing and/or quality control of agricultural products from harvest through consumption.

Part Five

Agricultural Biotechnology Skill Standards Grant Management Staff



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